



F-35 Lightning II Technology Transition

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VISION

DELIVER AND SUSTAIN

THE MOST ADVANCED, **AFFORDABLE** STRIKE FIGHTER AIRCRAFT TO
PROTECT FUTURE GENERATIONS WORLDWIDE.

MISSION STATEMENT

BE THE MODEL ACQUISITION PROGRAM FOR JOINT SERVICE AND
INTERNATIONAL COOPERATION.

DELIVER TO OUR WAR FIGHTERS AN **AFFORDABLE** AND EFFECTIVE
NEXT GENERATION STRIKE FIGHTER WEAPON SYSTEM AND SUSTAIN
IT WORLDWIDE.



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Positioned for Long-Term Growth



30+ Years of Production

Originally < 1,000
Projected

Over 4,300 Delivered

Global Program

Multiservice,
Multinational Program



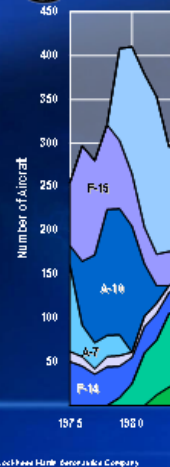
F-16 Like Potential



US Fighter Force Structure Recapitalization Mirrored in Coalition Partner Fleets



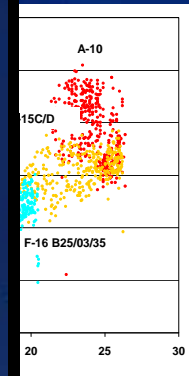
U.S. Fighter Force Procurement Quantities



Recapitalization Crisis - Aging Fighter Fleet



Quantum Leap in Capability



F-35 Is the Future

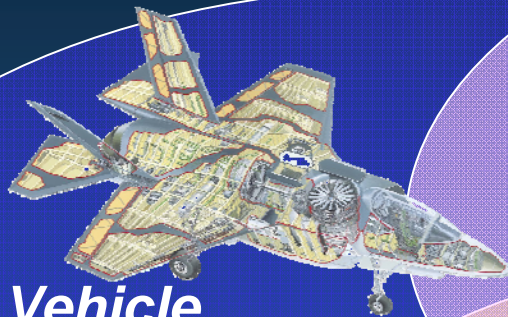


F-35 Is a Complex Air System



Air Vehicle

- 3 Major Teammates
- Global Supply Chain



Autonomic Logistics & Global Sustainment

- Reduced Ownership Cost
- Performance Based Logistics

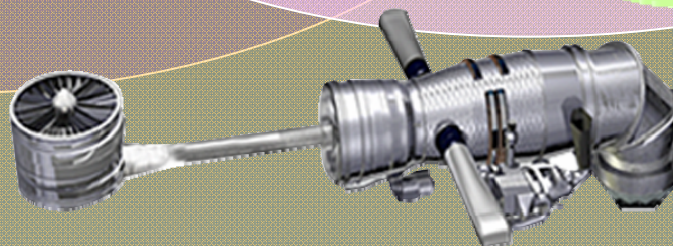


Air System



Propulsion

- 3 Major Companies
- Global Supply Chain





The Element of Surprise.....

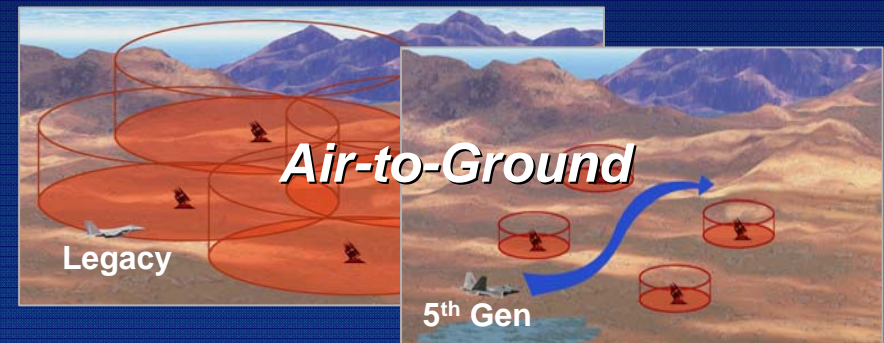
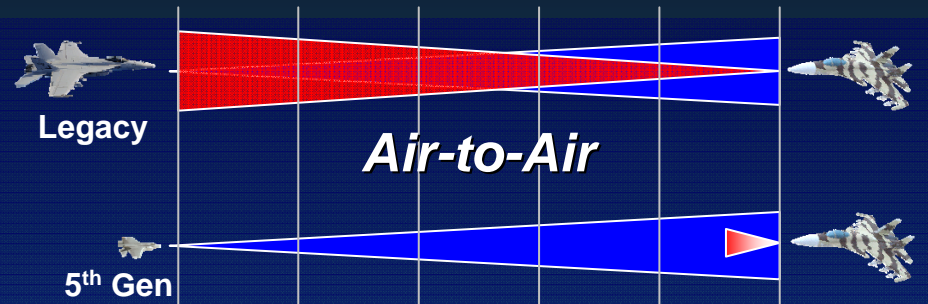


5th Generation Fighters Uniquely Integrate:



F-35

- Stealth
- Fighter Performance
- Total Situational Awareness
- Advanced Sustainment



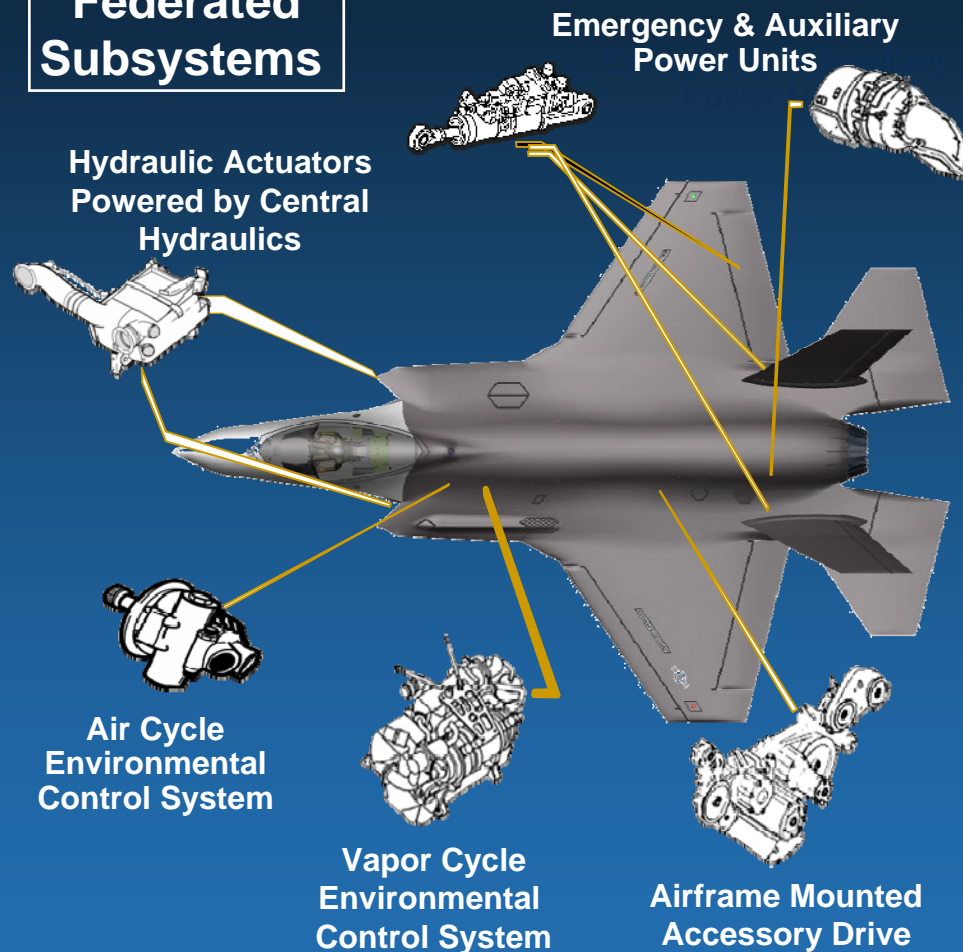
**Unmatched Counter Air, Strike, and ISR Mission Capability
Increases The Effectiveness of Legacy Forces**



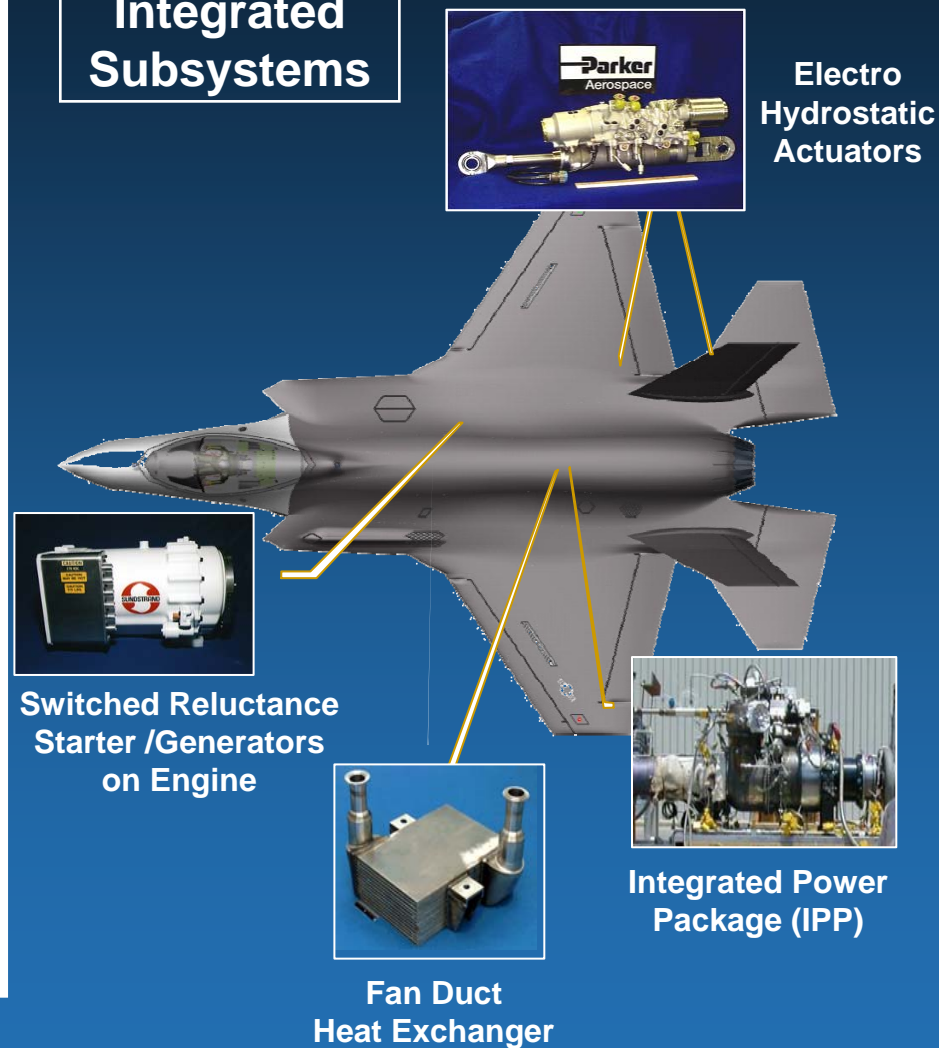
Complex Packaging



Federated Subsystems



Integrated Subsystems



**Highly Integrated Vehicle Systems
Drives More Electric Architecture**



....Plus Near Perfect Situational Awareness



Full Spherical Coverage by Distributed Aperture System (DAS)

Electro-Optical
Targeting
System (EOTS)

Active
Electronically
Scanned Array
(AESA)

RADAR

DAS Apertures

RWR
360° Coverage

Electronic
Support
Measures

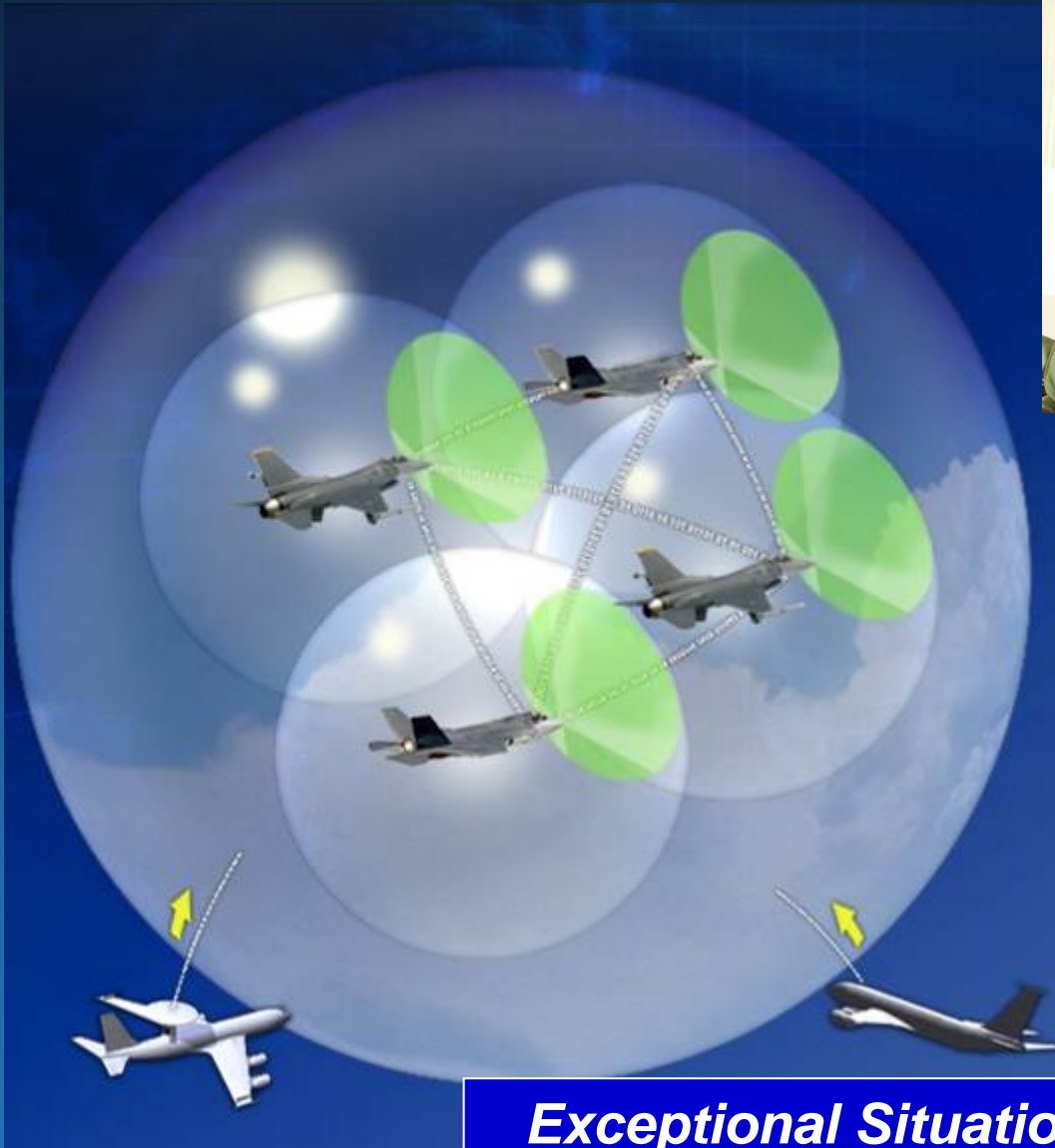
Emitter Locating

All Aspect Stealth – Low Observable

- SATCOM
- Data Links



Enabled By a Decision Making Cockpit.....



Exceptional Situational Awareness

Digital Thread Throughout Life-Cycle



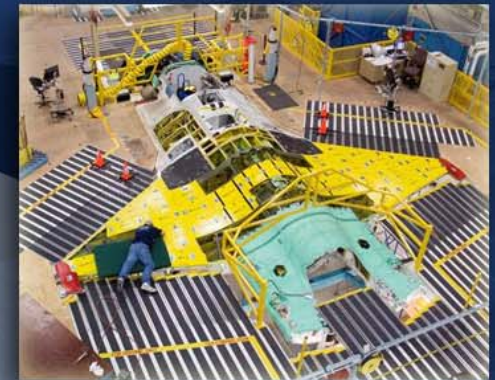
Design



Development



Build



**Program
Management**



**Support, Maintain
and Train**



Test



JSF Team



NORTHROP GRUMMAN

- Center Fuselage
- Weapons Bay Door Drives
- Arresting Gear
- Carrier Version (CV) Control and Test
- Radar
- Software
- Low Observable Support System
- Training Courseware and Management Systems

BAE SYSTEMS

- Aft Fuselage
- CV Wing Fold
- Fuel System
- Crew Escape
- Life Support
- EW System
- U.K. Support Center
- Throttle/Side Stick
- Horizontal/Vertical Tails
- Flight Control Computer
- STOVL Control and Test
- U.K. Rqts/Stores/SW

LOCKHEED MARTIN

Prime Contractor

- Air System Verification
- System Integration
- Mate Through Delivery
- Edges & Control Systems
- Autonomic Logistics
- Mission Systems
- Vehicle Systems
- Training System
- Forward Fuselage
- Wing

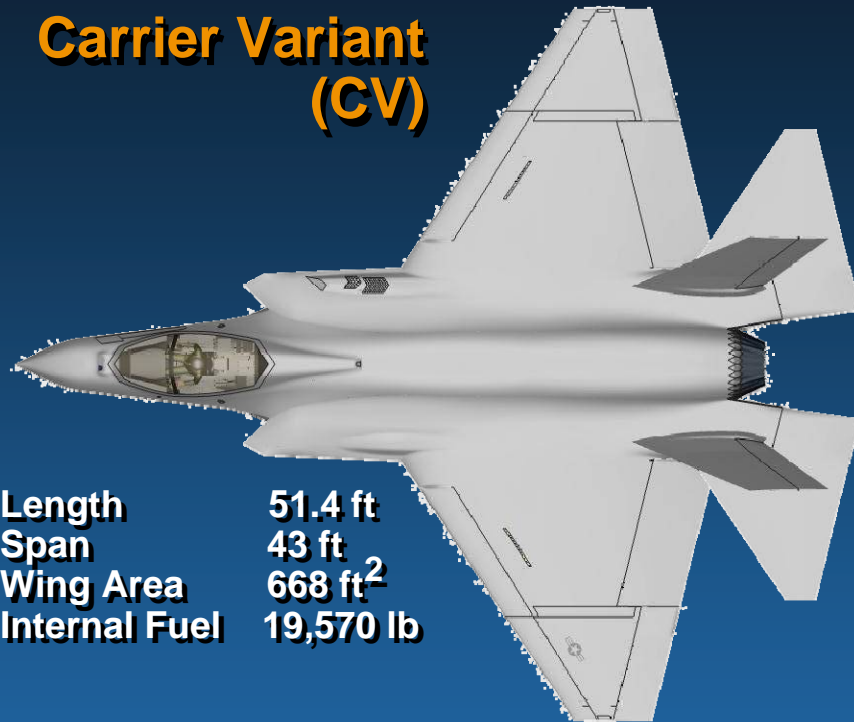
A Highly Integrated Global Team



Multi-Service Design



Carrier Variant (CV)



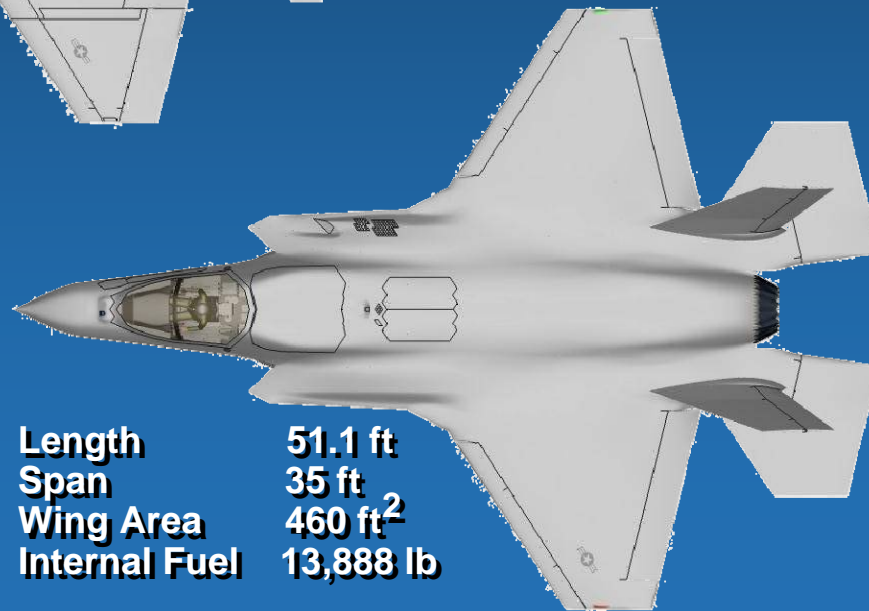
Length 51.4 ft
Span 43 ft
Wing Area 668 ft²
Internal Fuel 19,570 lb

Conventional Take-Off and Landing (CTOL)



Length 51.1 ft
Span 35 ft
Wing Area 460 ft²
Internal Fuel 18,073 lb

Short Take-Off and Vertical Landing (STOVL)



Length 51.1 ft
Span 35 ft
Wing Area 460 ft²
Internal Fuel 13,888 lb



Lockheed Martin Multi-Service Design



Carrier Variant (CV)

Probe and Drogue Refueling (Basket)

Strengthened Landing Gear and Tailhook

Wingfold and Ailerons Added

Probe and Drogue Refueling (Basket)

Lift Fan

Roll Posts

Larger Wing and Horizontal Tail Area

Centerline Gun Pod with 25mm Gun

Conventional Take-Off and Landing (CTOL)

In-Flight Refueling Door (Boom)

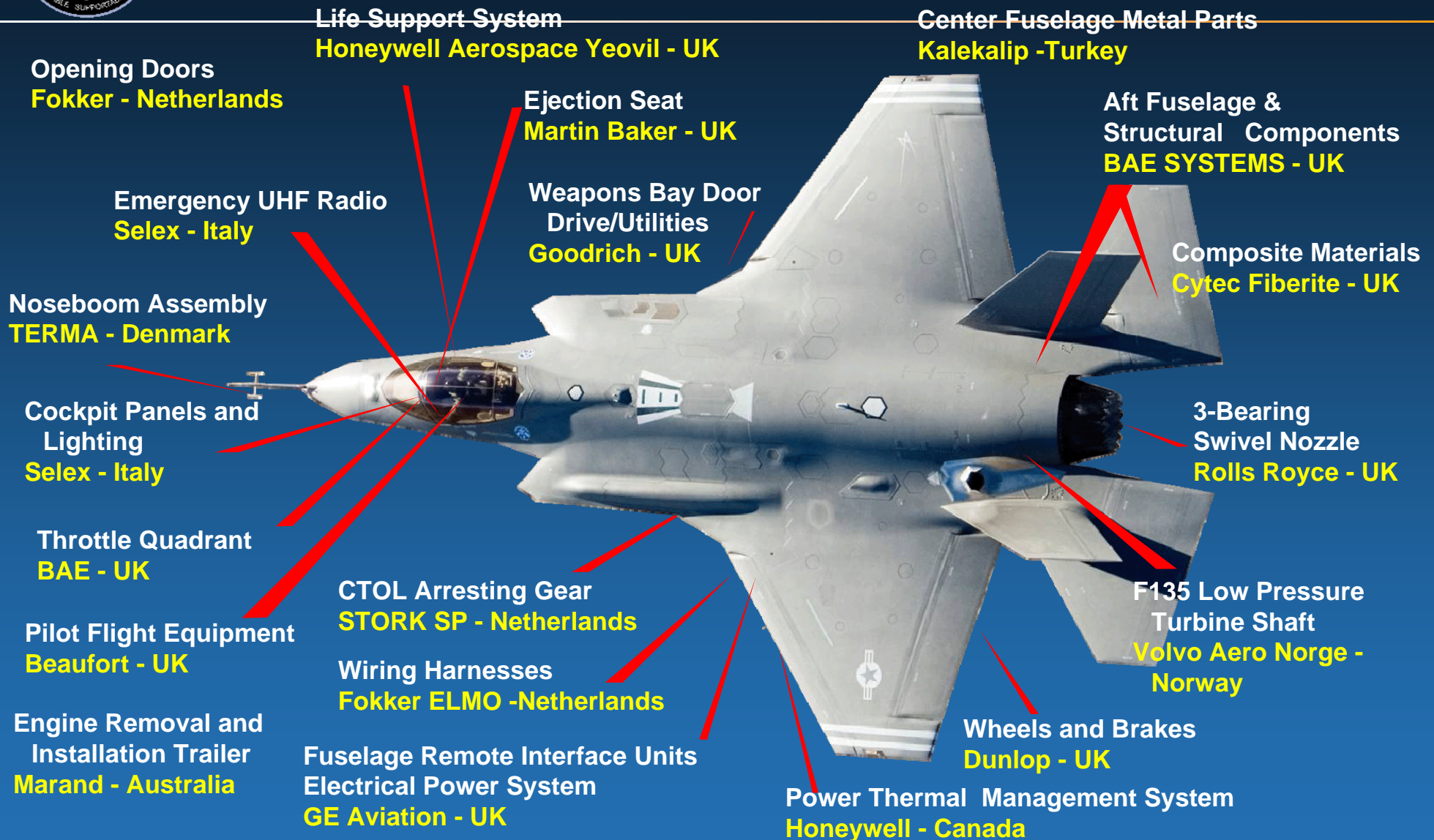
Internal 25mm 4-Barrel Gattling Gun

3-Bearing Swivel Nozzle

Short Take-Off and Vertical Landing (STOVL)



International Parts Flying on 1st CTOL Aircraft

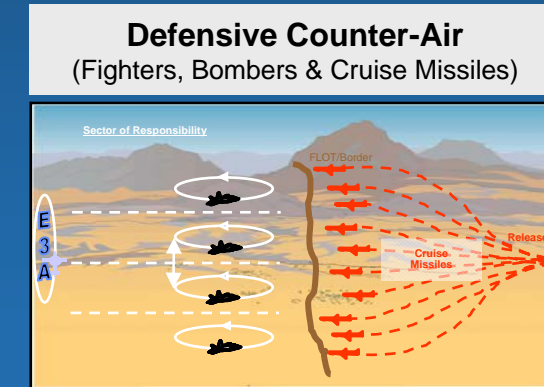
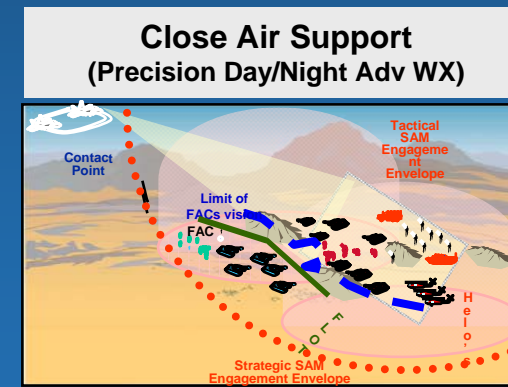
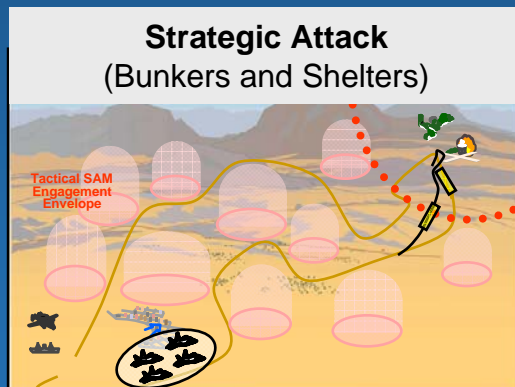
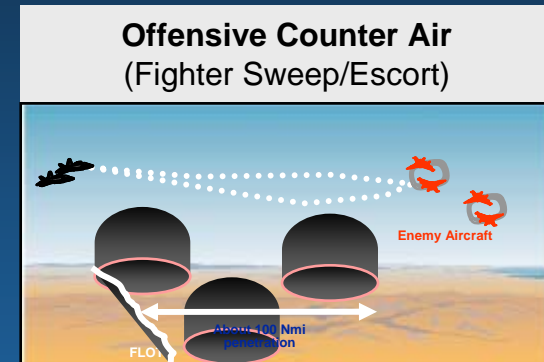
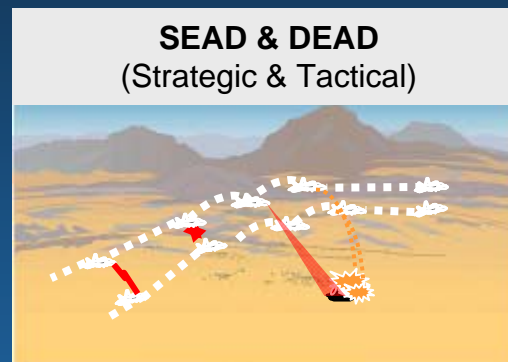
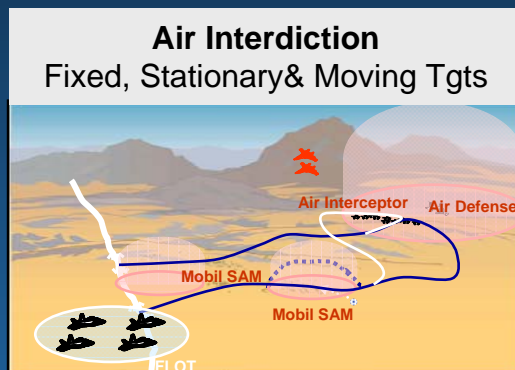


All 8 International Partners Have Parts on 1st Flight Test Aircraft



What F-35 Provides to the Warfighter

- Day “One” Stealthy (VLO) Supersonic, Multi-Role Fighter designed to execute Air-to-Air and Air-to-Ground missions in high threat areas:



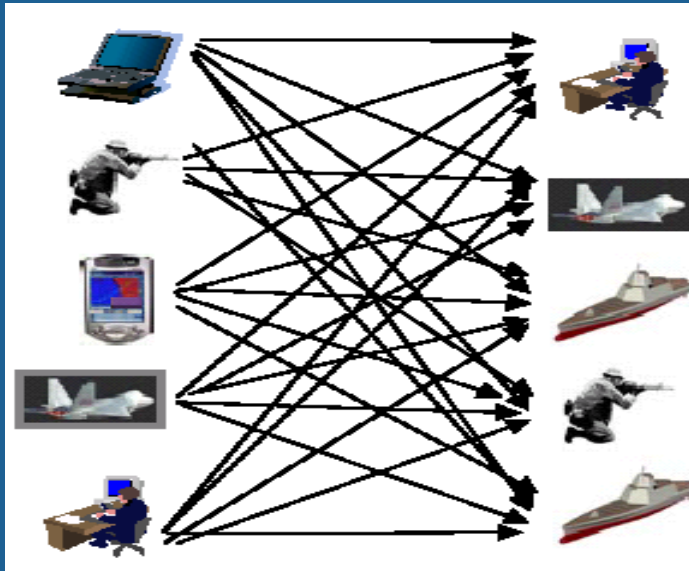
Versatile fighter which fulfills multiple missions



JSF In Middle of Warfighting Transformation



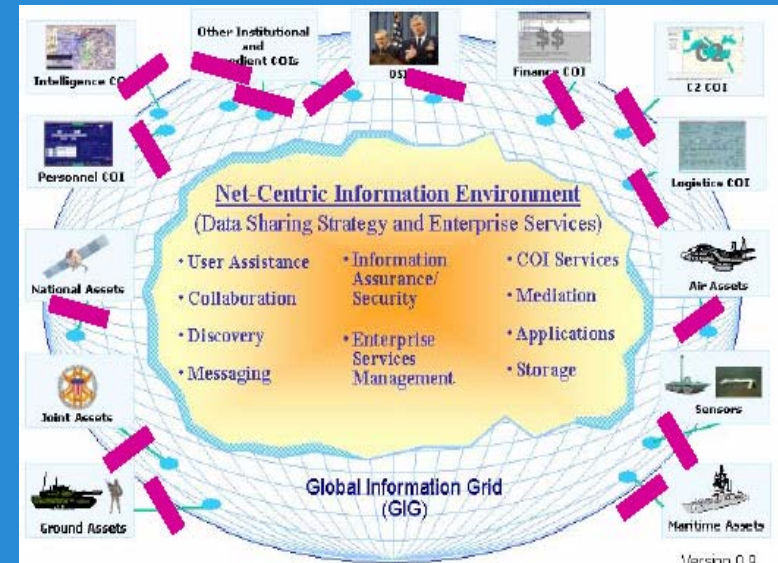
Present Environment



One-to-One Exchanges

- Interoperability Defined by Information Exchange Requirements (IERs)
- Strategy – Satisfy via Standards To Be Compatible With 2010 Architecture Defined via This Approach
- Measured by a Interoperability KPP

Net-Centric Environment

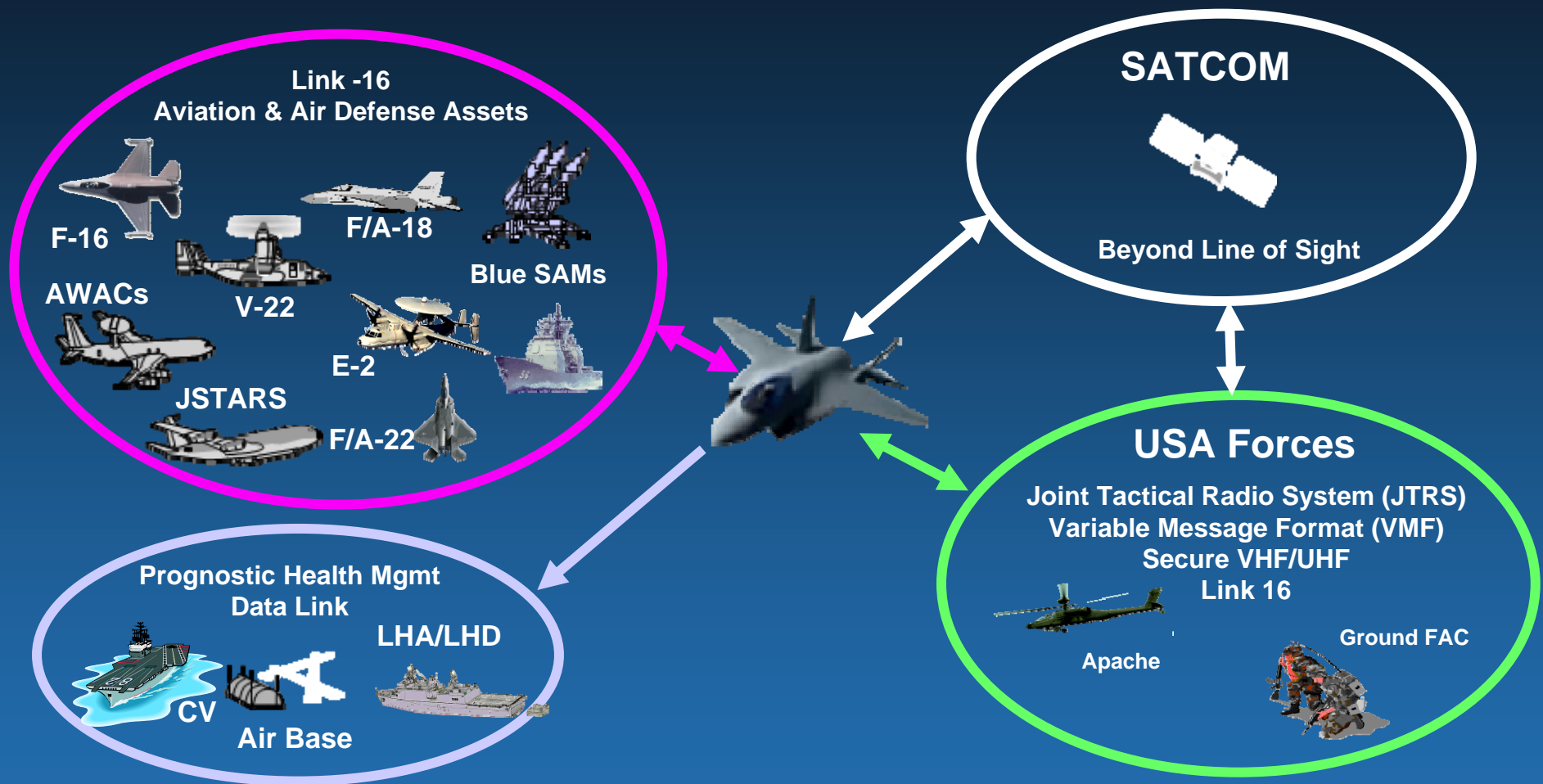


One-to-Many Exchanges

- “Publish and Subscribe” Networks
- Strategy – Develop JSF Air System With Sufficient Flexibility To Adapt To Changing Environment
- Managed Networks – Key Interface Profiles (KIP) and Enterprise Services
- Measured by a Net-Ready KPP



Voice and Data Link Interoperability



Over 120 Information Exchange Requirements to Ensure Interoperability Across US and Coalition Forces



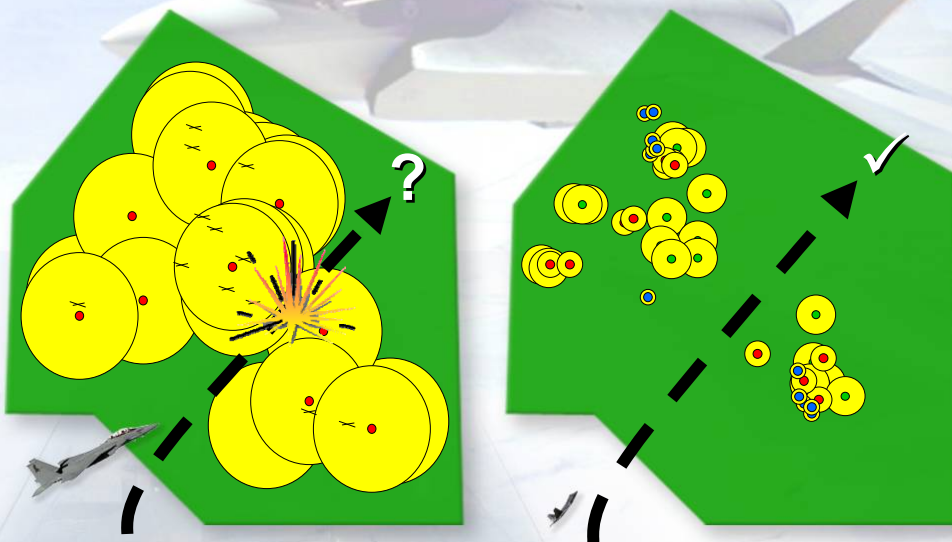
Survivability and Lethality



F-35: Designed and Built for Agile Stealth

Survivable Theater Access . . .

. . . With Increased Lethality

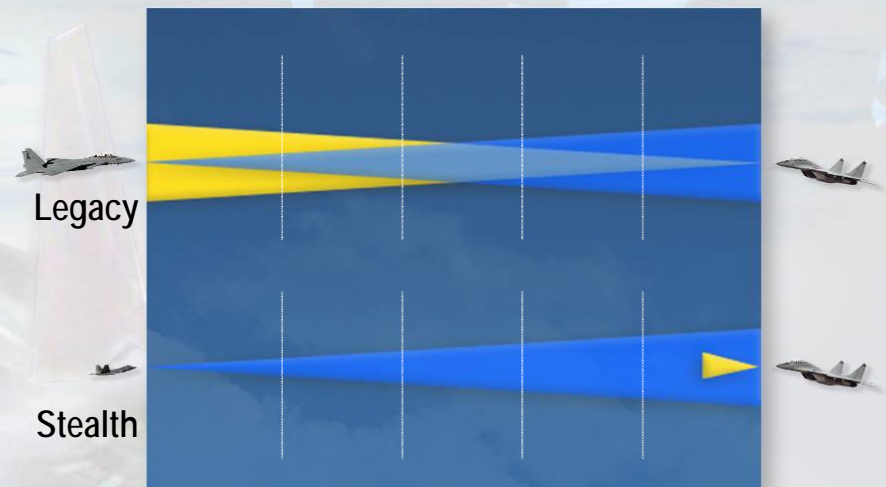


Legacy TACAIR

- Engaged and Shot by Ground Defenses
- Surprise Lost
- Mission Effectiveness Degraded/Lost
- Access Denied

5th Gen TACAIR

- No Tracks, No Shots
- Surprise Maintained
- Survivable and Lethal
- Access Assured



Legacy

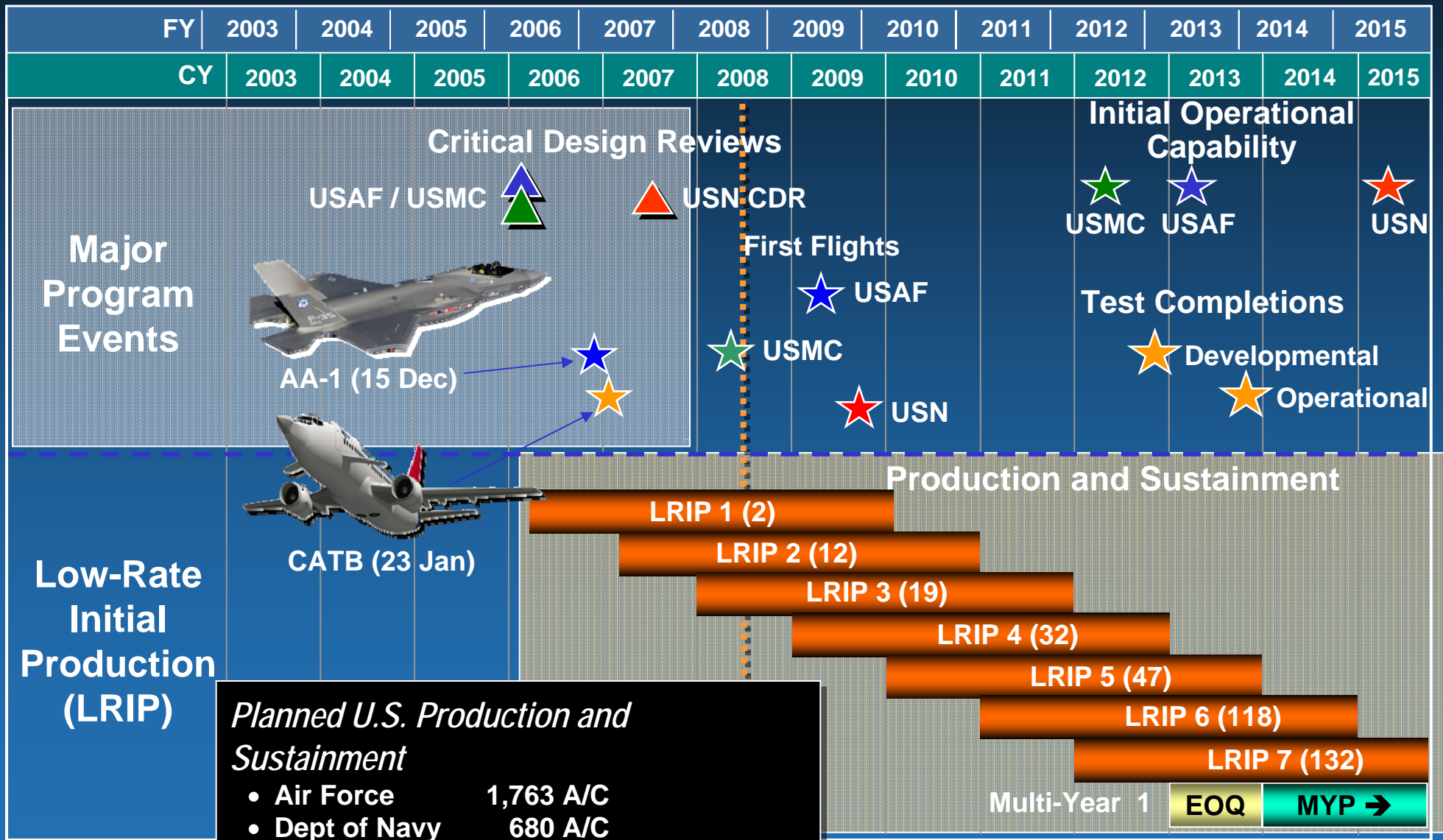
Stealth

**Stealth Shrinks
Air-to-Air Detection
Capability**

Tremendous Improvements in Combat Capability, Operational Flexibility, and Overall Force Efficiency in All Mission Areas



Master Schedule



EOQ = Economic Order Quantity

MYP = Multi-Year Procurement



Accomplishments Since Summer 2007



- **AA-1 Achieved 24 Successful Flights**
 - *Performed in-flight refueling with excellent flying qualities*
- **CATB Operations Initiated – CNI Successful Testing**
- **Joint Agreement of Functional Baseline Spec (FBS) & Verification Process**
- **Final Block 3 International Evaluations Successful**
- **CV CDR Completed**
 - *CV EPS/EHAS Solution Established*
- **96% of Initial BTPs and 56% (9.5M) of SLOC Released**
- **All 3 Variants in Production**
 - *CTOL and All STOVLs in Mate*
- **BF-1 Readied for Flight**
 - *Mitigated STOVL Propulsion System Delays*
- **DAB Approved:**
 - *Full Funding for LRIP 2 (6 CTOL and 6 STOVL)*
 - Pending BF-1 FF + F135 turbine blade redesign resolution
 - *Long Lead for LRIP 3 (8 CTOL / 8 STOVL)*
 - *1 year extension of SDD to complete DT and OT*
- **Stabilized URF Estimates**



Precision Fabrication



Flexible/Automated Solutions



Advanced Manufacturing Technologies

Lean Practices



Digital Assembly





Jan Feb Mar Apr May June July Aug Sep Oct Nov Dec



BF-1 Structural Coupling Tests Start



BF-1: Hover Pit Testing



BF-1 1st Flight



**LRIP #3 FF
Proposal
Submitted**



AF-1 Power On



BF-3 Rollout



CF-1 Start Major Mate



Sustainment Readiness Review-PAX



AF-1 Rollout



BF-4 Rollout



**CATB 1st
Federated
Flt**



Maintenance Training CDR



ALIS 1.0.2 Delivery



AG-1 Static Test Start



LRIP #3 LL
Approved



BF-2 Rollout





Flight Test Underway



Objectives

- Mission Systems Risk Reduction
- Missions Systems Integration
- Verification

Status

- 37 Flights; 105.7 Flt Hrs, 13.5 Test Hrs
- CNI Sorties – Good flight test data obtained
- Radar and EW integration mod underway
- Block 0.5 Mission Systems testing starts Oct 08



Objectives

- Risk Reduction
- Basic Envelope Expansion
- Systems Integration

Status

- 43 Flights, 51.7 Flt Hrs
- 38,000 Feet, 0.89 Mach, 20 Degrees AoA
- Initial Air Refueling Tests Complete
- Air Starts planned during EDW deployment

CATB

23 Jan '07



STOVL

11 Jun '08



CTOL

2009



CV

2009





BF-1 Status



Roadmap

- | | |
|----------------------------|------------|
| • Airworthiness | Jun-Jul 08 |
| • Flying Qualities | Aug-Sep 08 |
| • Hover Pit | Feb 09 |
| • Initial STOVL Transition | Mar 09 |
| • Ferry to PAX River | Apr 09 |
| • Vertical Landing Buildup | May-Jul 09 |



Flight Test Status


- 1st Flight – 11 Jun 08
- 4 Flights, 3.3 flight hours
- Altitude to 15K / 275 KCAS max
- Multiple land gear cycles at 200 KCAS





The Future Is Upon Us



	BLK 0.5		BLK 1	BLK 2	BLK 3													
	LRIP 1	LRIP 2	LRIP 3	LRIP 4	LRIP 5	LRIP 6	LRIP 7	MY 1						MY 2				
Buy Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
Delivery Year	2010	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	
USAF - CTOL	2	6	8	12	24	42	48	66	80	80	80	80	80	80	80	80	80	
DoN - CV				4	6	15	17	25	25	25	25	25	25	25	25	25	25	
DoN - STOVL		6	8	14	13	25	25	25	25	25	25	25	25	25	25	25	25	
UK - STOVL			2	1		6	1	8	11	12	13	12	12	7	2	1	1	
IT - STOVL						4	3	3	3	3	14	14	12	1				
IT - CTOL						2	3	11	11	11				11	12	12	1	
AS - CTOL					4	8	15	15	15	15	15	13						
CA - CTOL								16	16	16	16	16						
DK - CTOL								8	8	8	8	8	8					
NL - CTOL			1	1		6	10	10	12	12	12	12	9					
NO - CTOL								8	12	12	12	4						
TR - CTOL						10	10	10	12	12	10	10	10	10	6			
TOTAL	2	12	19	32	47	118	132	205	230	231	230	219	181	159	150	143	132	

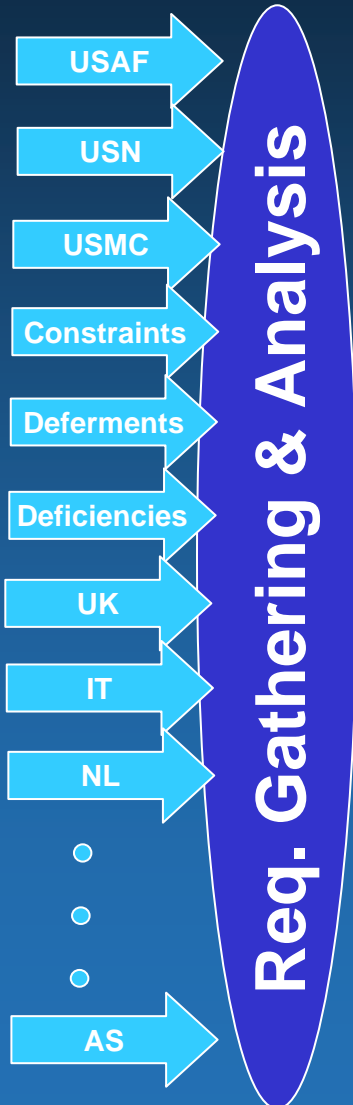
Source: JSF.mil website – Annex A Revision April 2007



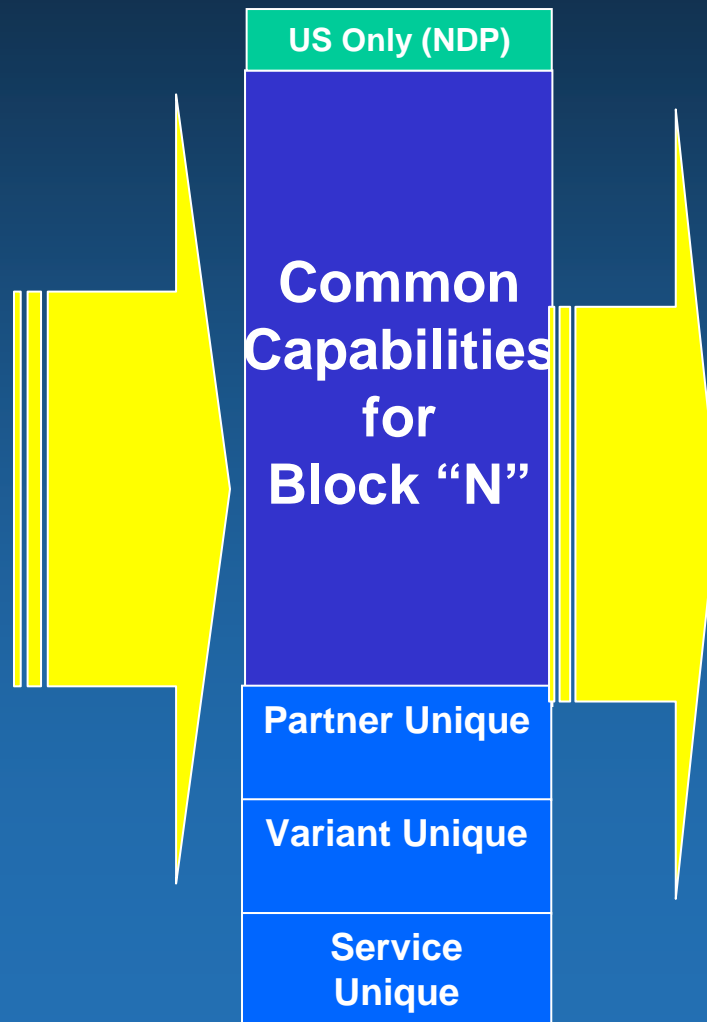
Follow-on Development Concept



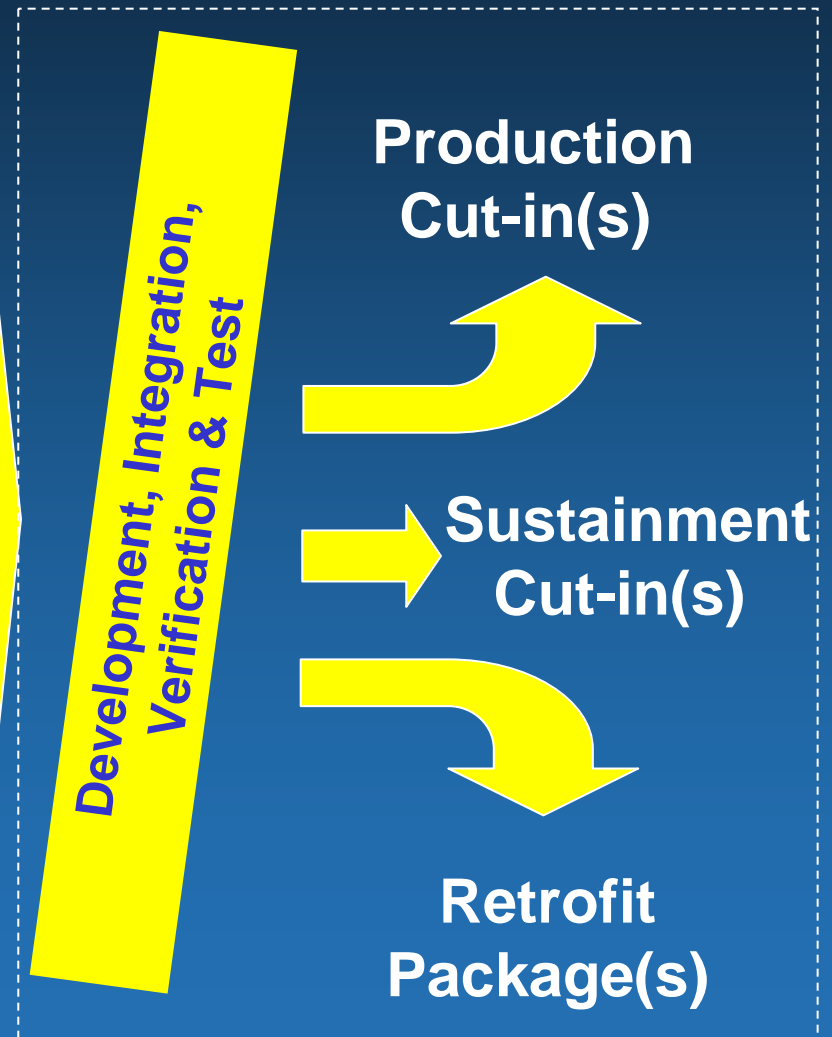
Definition



Selection



Contracted Effort

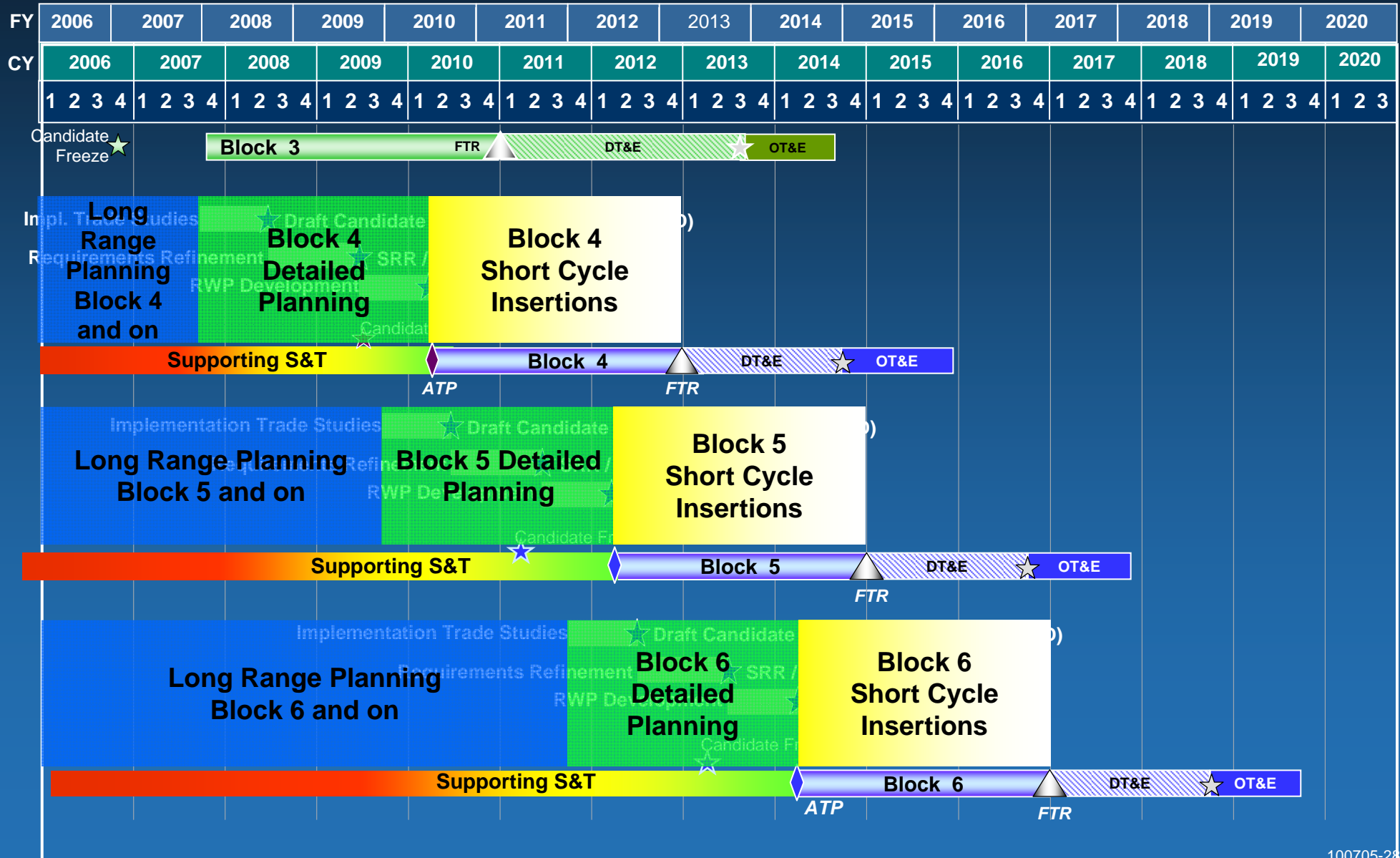




Post-SDD Block Increment Planning

Notional Timelines

"Technology Insertion Points"





Follow-on Development - Platform Contractor/JPO are doing our Homework



- **Contractor/JPO are developing Roadmaps to show**
 - *What the warfighter's needs are – COCOM Gap Analysis*
 - *Where are we going in “focus areas”*
 - *When technologies need to fit into the JSF S&T roadmap*
- **S&T programs must buy their way into the JSF Air System**
 - *Measurable IMPROVED performance, reliability & maintainability and/or supportability basis*
 - *A solid business case, i.e. REDUCED URF (Unit Recurring Flyaway Cost), Total Ownership Cost, and ROI (Return on Investment)?*
- **JSF S&T Planning Document**
 - *Provides technology needs, priorities and schedule*
 - *Available on request as appropriate*



JSF S&T Future Planning



- **JSF S&T Focus**

- *Incorporate mature technologies into baseline*
- *Increasing capabilities for strike warfare*

- **JSF S&T Planning Document**

- *Strategy & guidance for investments*
- *Potential Enhancements*
- *Roadmaps & projects*



S&T Technology Opportunity Categories

- **Air System Core Capability**
- **Air-to-Surface**
- **Air-to-Air**
- **Electronic Combat**
- **Interoperability and ISR**
- **Airframe & Infrastructure**
- **Supportability / Sustainment**
- **Manufacturing and Producibility**



Technology Roadmap Needs



- **Air System Core Capability**
 - *Collision Avoidance*
 - *Cockpit Automation*
 - *Embedded Training*
- **Air-to-Surface**
 - *“Dial a Yield” Weapons*
 - *Combat ID*
 - *Locate Targets in Complex Environments*
 - *Small Weapon Precision Kill*
 - *Improved Battle Damage Assessment*



Technology Roadmap Needs



- **Air-to-Air**
 - *Combat ID*
 - *Longer Range Missiles*
 - *Faster Missiles*
 - *Passive Threat Detection*
- **Electronic Combat**
 - *Threat Detection*
 - *Active Countermeasures*
 - *Electronic Attack*
 - *Directed Energy Effects*



Technology Roadmap Needs



- **Interoperability and ISR**
 - *LPI Networks*
 - *Information and Resource Management*
 - *Improved Bandwidth*
 - *Battle Management*
- **Airframe and Infrastructure**
 - *Propulsion (Fuel/Thrust)*
 - *Reduced Weight*
 - *Thermal Management*
 - *Mass Storage Capacity*
 - *Electric Power and Power Electronics*
 - *Actuator Systems*



Technology Roadmap Needs



- **Supportability and Sustainment**
 - *Fault Detection and Isolation*
 - *Non-skid Coatings*
 - *Diagnostics, Prognostics, and Health Monitoring*
 - *Environmentally Safe Primers and Coatings*
- **Manufacturing and Producibility**
 - *Span Time Reduction*
 - *High Temperature Materials*
 - *Assembly Automation*
 - *Supportable and Affordable LO Technologies*
 - *Coatings*



S&T Opportunities



- **Requirements Pull**
 - *Potential Themes for Upgrades*
 - Missions
 - Emerging Threats
 - Basic Capabilities
 - Net Centric Capabilities
 - Sustainment
 - Enduring Themes (Weight, URF, Production, Thermal)
- **Technology Push**
 - *What aren't we thinking about?*
 - Emerging Technology
 - ???



Effective Transition Planning



- Technology must satisfy a valid requirement
- Candidate must have a high Benefit to Cost ratio
- Project(s) must have a feasible Business Plan
- Development Funding Sponsorship must be identified
- Technology Transition Agreement / Plan must be written
 - *Clearly defined success criteria*
 - *Alternatives & Offramps identified*
 - *Transition funding identified (as required)*
- Essential to maintain close coordination
 - *Technologists; IPTs; Management; Requirements community*
 - *Acquisition Funding community*
 - *Formal and informal communication*



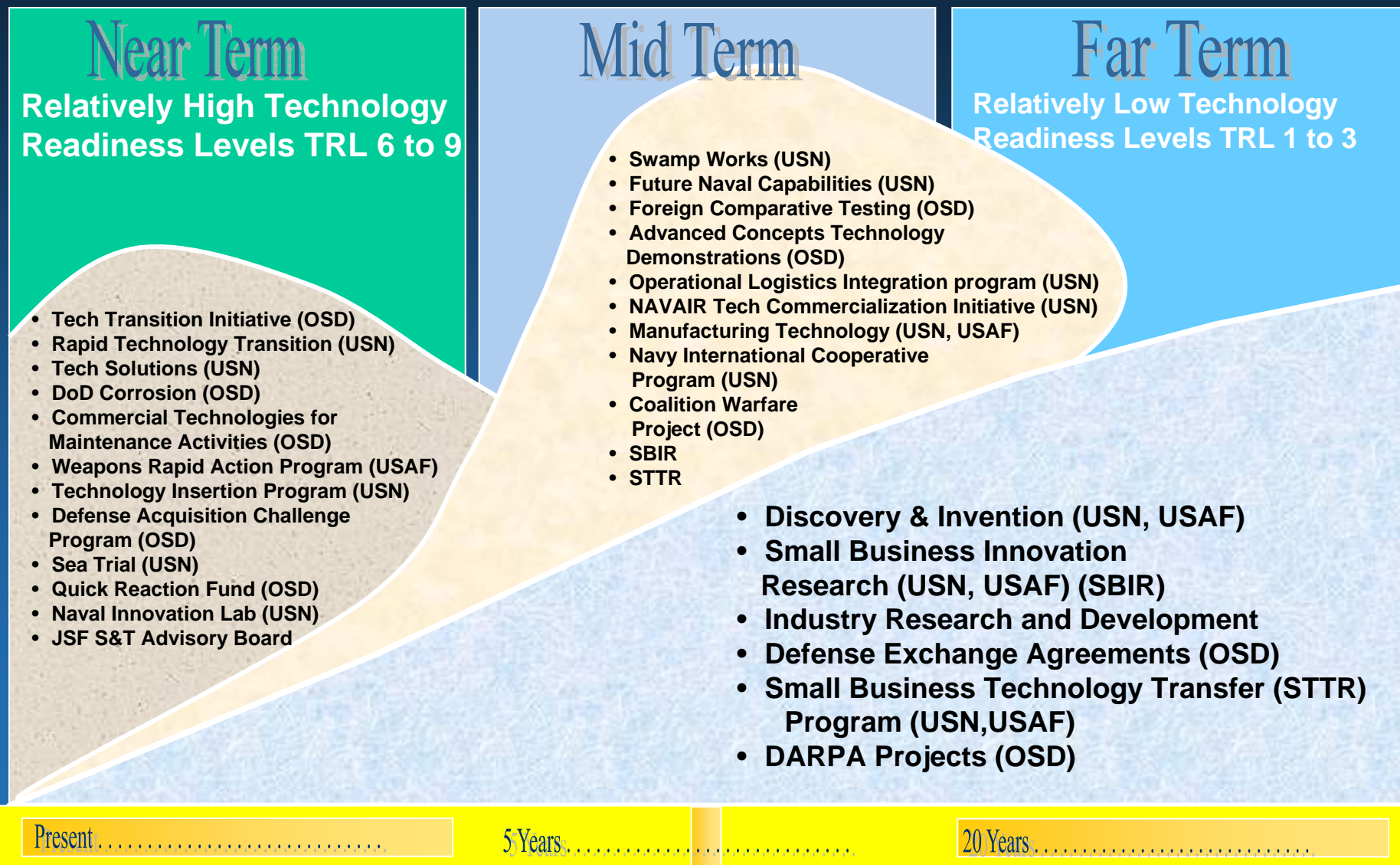
Leveraging External Funding



- JSF Program funds very limited for transition
- Need to establish the tech transition path to the platform early on through prime contractor and sub-prime involvement
 - *JSF is a Total System Performance Responsibility (TSPR) program. No technology makes it on the jet without the Prime and Sub-prime's concurrence!*
- Focus is to leverage non-JSF funding for transition such as:
 - **Service programs**
 - Warfighter Rapid Acquisition Program (USAF WRAP)
 - Rapid Technology Transition (USN RTT)
 - Manufacturing Technology (USAF & USN MANTECH)
 - SBIR Commercialization Pilot Program (CPP)
 - **DoD Programs**
 - Technology Transition Initiative (TTI)
 - Defense Acquisition Challenge Program (DACP)
 - Foreign Comparative Testing (FCT)



JSF US Funding Opportunities for Technology Transition





New Technology Requirements Summation



- **Communicate the technology challenge**
 - *Product*
 - *Timeline*
- **Identify potential solutions**
 - *Is the technology challenge already being addressed*
 - *Are there technology gaps that need to be addressed*
 - *Where can we leverage funding*
- **Planning doesn't end today. It's an ongoing process.**



JSF S&T Team



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